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# THE CLEANSING EFFECT OF RAIN ON SILT CONTAMINATED PASTURE

## INTRODUCTION

Grass in fields in the Axe valley which had been flooded on 30 May 1979 were heavily contaminated with silt after the flood waters had drained off. The pastures were monitored over the following 3 weeks and the object of this analysis is to explain the observed reduction of silica content of the grass.

## DATA

Grass samples were cut at 75 mm above the ground and their % silica was determined. Hay samples were also taken from some sites but farmers had generally cut lower than 75 mm and the samples were usually much more heavily contaminated. This analysis has, therefore, been confined to grass samples. The data are shown in Table 1.

## HYPOTHESES

It is assumed that the rate of decrease of silica is proportional to the excess silica above the average of that at the control site. The rate of decrease of silica may be independent of the weather (hypothesis 1) or may be proportional to the rate of rainfall (hypothesis 2).

If S is the % silica

Sc is the average % silica on the control plot = 1%

So is the % silica at the start of monitoring

t is time (days)

R is accumulated rainfall in mm

$\alpha$ and B are constants

Then mathematically hyposesis 1 is:-

$$\frac{ds}{dt} = -(S - Sc)\alpha \quad \text{ie } S - Sc = (So - Sc) \exp(-\alpha t) \text{-------} (1)$$

Hypothesis 2 is:-

$$\frac{ds}{dt} = -(S - Sc)\, B \frac{dR}{dt} \quad \text{ie } S - Sc = (So - Sc) \exp(-BR) \text{ ---} (2)$$

## ANALYSIS

Equation (1) may be written as:

$$\log_e \frac{(S - Sc)}{(So - Sc)} = -\alpha t$$

If $\log_e \frac{(S - Sc)}{(So - Sc)}$ is plotted against 't', the number of days from the start of monitoring, then we should get a straight line with slope $-\alpha$ if the hypothesis is correct. Such a plot is shown in figure 1.

Similarly a plot of $\log_c \frac{(S - Sc)}{(So - Sc)}$ against 'R' should give a straight line if that hypothesis is correct. That plot is shown in figure 2. The data from which the two graphs were plotted is given in Table 2.

Using the values of $\alpha$ and B estimated from figures 1 and 2, equations 1 and 2 have been used to predict the % silica on all grass samples from 7.6.79 onwards. The results are shown in Table 3.

DISCUSSIONS AND CONCLUSIONS

The data suggest that the reduction of silt on grass that has been flooded is more closely related to accumulated rainfall after the flood has receded than it is to time. Unfortunately there is so much scatter in the data that the difference between the two relationships is not statistically significant. Nevertheless, rainfall is the better predictor for this data sample and there are good physical reasons for preferring it to time. It is, therefore, suggested that if predictions of silica reduction are required after a future flood the following equation should be used:-

$$S - 1 = (So - 1) \exp (- 0.124 R) \quad \text{----------(3)}$$

Where So is the % silica immediately after the flood
S is the % silica after rainfall R mm.

The moderate amount of rain required to reduce the silica content of grass to an acceptable level means that irrigation equipment could be used to clean pastures after a flood.

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August 1979

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TABLE 1

PERCENTAGE SILICA IN GRASS SAMPLES

| Date | 4.6.79 | 7.6.79 | 11.6.79 | 15.6.79 | 19.6.79 |
|---|---|---|---|---|---|
| Site | | | | | |
| 1 | 6.01 | 4.25 | 4.34 | 1.88 | 2.93 |
| 2 | 2.92 | 3.10 | 2.17 | 1.46 | - |
| 3 | 0.84 | 1.04 | 1.14 | 1.11 | - |
| 4 | 9.86 | 5.82 | - | - | - |
| 7 | 5.28 | - | - | - | 2.48 |
| 8 | 9.71 | - | - | - | 2.30 |
| 10 | 8.87 | - | - | - | 1.44 |

NOTE: Site 3 was the control site.

TABLE 2

DATA FROM WHICH FIGURES 1 AND 2 WERE PLOTTED

| Day | 0 | 3 | 7 | 11 | 15 |
|---|---|---|---|---|---|
| R | 0 | 3.2 | 3.7 | 12.1 | 14.3 |
| Site | | $\log_e \frac{(S - 1)}{(So - 1)}$ | | | |
| 1 | 0 | -0.43 | -0.41 | -1.74 | -0.95 |
| 2 | 0 | 0.09 | -0.49 | -1.43 | - |
| 4 | 0 | -0.61 | - | - | - |
| 7 | 0 | - | - | - | -1.06 |
| 8 | 0 | - | - | - | -1.90 |
| 10 | 0 | - | - | - | -2.88 |
| Mean | 0 | -0.32 | -0.45 | -1.58 | -1.70 |

TABLE 3

PREDICTIONS OF THE PERCENTAGE OF SILICA ON GRASS

| Date | Site | % Silica | | | | |
|---|---|---|---|---|---|---|
| | | Measured Quantity | Predicted from Time Quantity | Error | Predicted from Rain Quantity | Error |
| 7.6.79 | 1 | 4.25 | 4.59 | 0.34 | 4.37 | 0.12 |
| | 2 | 3.10 | 2.38 | -0.72 | 2.29 | -0.81 |
| | 4 | 5.82 | 7.35 | 1.53 | 6.96 | 1.14 |
| 11.6.79 | 1 | 4.34 | 3.30 | -1.04 | 4.17 | -0.17 |
| | 2 | 2.17 | 1.88 | -0.29 | 2.21 | 0.04 |
| 15.6.79 | 1 | 1.88 | 2.48 | 0.60 | 2.12 | 0.24 |
| | 2 | 1.46 | 1.57 | 0.11 | 1.43 | -0.03 |
| 19.6.79 | 1 | 2.93 | 1.95 | -0.98 | 1.85 | -1.08 |
| | 7 | 2.48 | 1.81 | -0.67 | 1.73 | -0.75 |
| | 8 | 2.30 | 2.65 | 0.35 | 2.48 | 0.18 |
| | 10 | 1.44 | 2.49 | 1.05 | 2.34 | 0.90 |
| Mean | | 2.925 | 2.950 | 0.025 | 2.905 | -0.020 |
| SD | | 1.370 | 1.684 | 0.845 | 1.638 | 0.680 |

Figure 1

The relationship between excess silica and time

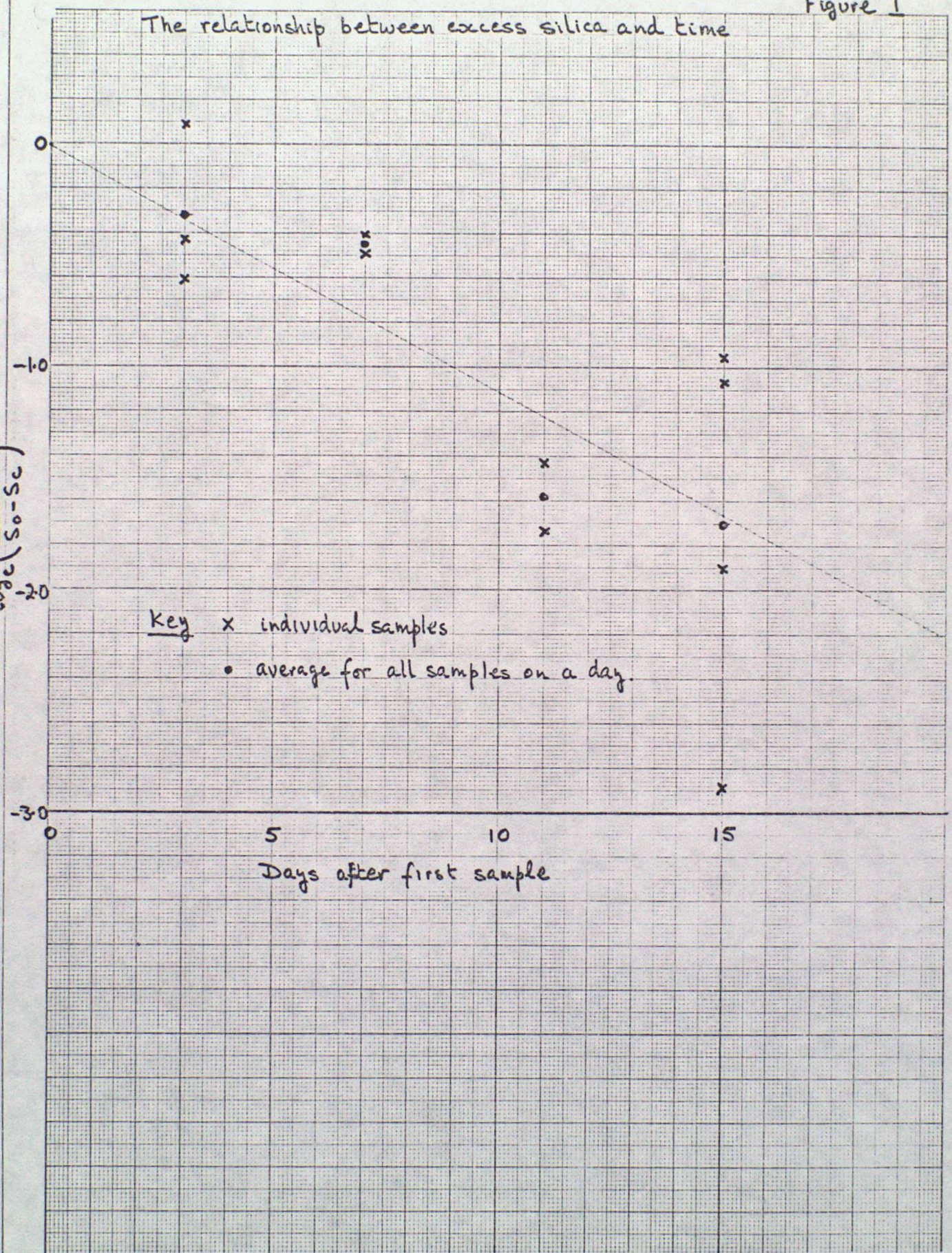
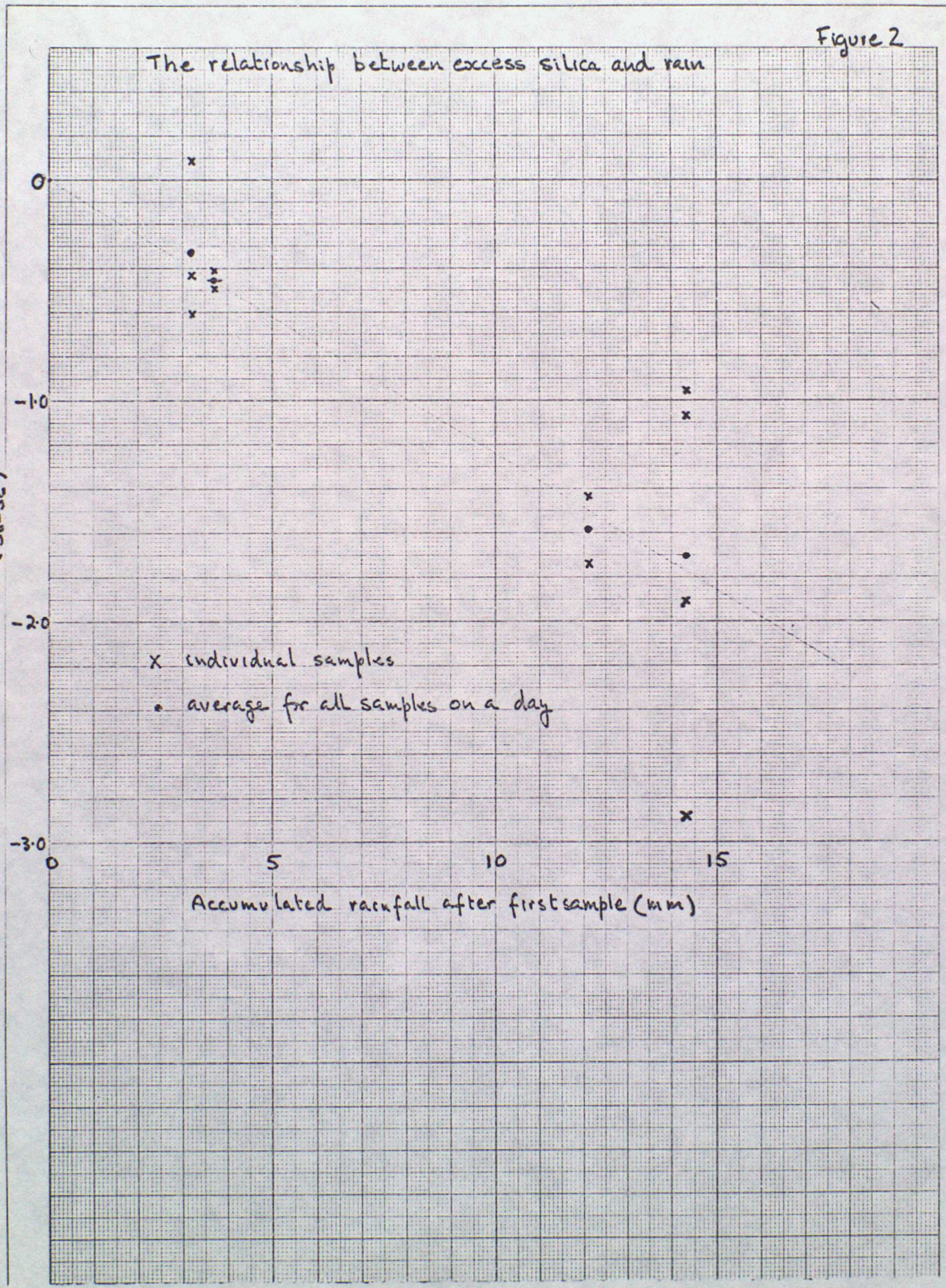


Figure 2


The relationship between excess silica and rain
0
-1·0
-2·0
-3·0
$\log_e\left(\frac{S-Sc}{So-Sc}\right)$
0
5
10
15
Accumulated rainfall after first sample (mm)
x individual samples
• average for all samples on a day